Tales of the Sausage Factory

First Reactions To The FCC's 600 MHz Band Plan Workshop.

By HAROLD / MAY 6, 2013

I was pleased to participate in the FCC's 600 MHz auction (aka the Incentive Auction) band plan workshop last Friday. This was a pretty intense nerd-fest, with discussion limited as much as possible to real honest-to-God technical issues that arise with the band plan. While I knew some of this, the full scope of the problems associated with developing a band plan for this auction had not truly become clear to me until I sat through about 6 hours of technical discussion on the subject.

My biggest take away from this is that about the only way to get a rational bandplan on this is to go back in time to 1996 and tell Congress not to stop at Channel 51, but to clear all the way to Channel 37. Then, we go ahead to 2002, and tell Congress not to require the FCC to hold the first 700 MHz auction so we can actually com up with a rational band plan ion 2007. Given that I am unlikely to find either a souped-up DeLorean or a blue police box anytime soon, we are probably stuck with the existing constraints.

Most importantly, all the people yapping about how the FCC needs to focus on getting the maximum amount of spectrum to maximize revenue, please review this workshop before you open your yaps again. Srsly.

I explain why people who seriously care about the auction outcomes — even if it is only from a revenue maximization perspective — need to actually care about the technical issues before blathering on about recovering the most spectrum below . . . .

Two critical factors quickly emerge. First, the band plan becomes enormously more complicated if the FCC clears more than 84 MHz of spectrum. 84 MHz would clear the band from existing Channel 51 to existing Channel 37. As Channel 37 is allocated to medical devices and radio astronomy (which everyone agrees cannot be moved), Channel 37 forms a natural guard band.

But more importantly, the physics of the spectrum change significantly below Channel 37. According to Qualcomm, the change is sufficiently dramatic that a handset with an antenna that works for lower band spectrum between Channel 37 and 1 GHz cannot (affordably) have a second antenna for spectrum below Channel 37. This gives you three basic choices (see FCC materials here):

1. The FCC's original down from 51 for uplink/down from 37 for downlink. This spreads the pain around to the industry and makes all the spectrum blocks "fungible" (no spectrum is better than any other). Broadcasters and

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wireless carriers generally hate this, because it puts broadcast stations in the middle of the "duplex gap" between uplink and downlink where it will purportedly interfere with downlink operations and interfere with broadcasting. OTOH, no one at the technical panel explained why putting broadcast stations in the middle of a 20 MHz duplex gap (and thus 10 MHz away from a downlink) will cause interference, but putting a broadcast station on the other side of a 5 MHz guard band does not cause interference. This is especially puzzling when the later moves the broadcast station to lower frequencies than putting it in the duplex gap.

This approach (called the "Down from 51/Down from 37" plan) may also significantly reduce cost to the government by making it easier to repack broadcasters, since broadcasters will be in the duplex gap as well as shoved down between Channel 7 and whatever lies unused south of 37. That helps on geographic spacing, and creates more channels above Channel 7 for broadcasting. (Under the statute, broadcasters may not be involuntarily reallocated below Channel 37.) Since revenue to the government is not simply the total gross receipts from the auction, but gross receipts ***minus*** costs to the government of (a) paying off broadcasters for their spectrum use rights and (b) relocating broadcasters that chose to retain some or all of their broadcast spectrum rights. A plan that significantly reduces relocation cost may yield significantly more revenue to the Treasury even if it creates more guard band space in the form of a substantial duplex gap.

On the flip side, wireless providers are certain to discount their bids for the technical integration problem of how to include the spectrum south of Channel 37. On the other hand, because the spectrum will be fungible, this effect will be distributed to the entire industry, maximizing the likelihood of a solution. So will wireless carriers be optimists and assume that if the entire industry needs it they will eventually be able to figure it out, and therefore discount their bids only modestly? Or will they be pessimists and conclude that they should wait and pick up the spectrum in the secondary market after the solution is developed, and thus discount their bids heavily? This is not easy to say, as a solution to this problem is also subject to the more general solution of the vexing problem of multi-banded handsets.

2. Clear from Channel 51 and keep going. The most popular plans with both wireless carriers and broadcasters is the "Down from 51" plan. Start clearing from Channel 51 and see how far you get, leaving a lump at Channel 37. This plan reduces the size of the duplex gap, but may increase the absolute quantity of guardband space depending on how much you break up the spectrum between uplink and downlink.

In addition to the problem of needing guardbands between services and a duplex gap for paired spectrum, you have the problem of the break at Channel 37. Those favoring the "Down from 51" plan propose using spectrum south of Channel 37 as supplemental downlinks ("SDLs"). They argue that traffic these days is asymetric, so there is value in selling licenses that are for downlink only. Mind you, this assumes that traffic is going to stay asymmetric, an increasingly doubtful assumption based on expectations that users will be more uploading video blogs and pictures and other bandwidth intensive things (like medical records). Unless, of course, we make dumb choices that lock in today's traffic patterns, in which case what users five years from now actually want and/or need will be irrelevant.

(A word of explanation, when using Frequency Division Duplexing (FDD), the most common form of two-way architecture in the U.S., you need to

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pair bands of spectrum and have one designated "up" (from handset to cell tower) and "down" (from cell tower to handset). To make standard equipment for all carriers and to avoid interference, you cannot have carriers using a SDL as an uplink, even if the carrier would prefer to have an uplink in low-band spectrum.)

This plan actually creates the **biggest problems** for efficient use of spectrum, competition and — in my opinion — auction revenue. So *of course* this is the plan backed by the majority of carriers (including AT&T and Verizon), the majority of equipment manufacturers, and the broadcasters. For starters, it is the plan that maximizes the total number of guardbands and still retains a duplex gap. Because the proposed duplex gap is smaller than in Down from 51/Down from 37, and because different proposals make different assumptions about the necessary size of guardbands between services and supplemental downlinks, this often gets lost.

The biggest problem is the antenna problem below Channel 37. That makes any spectrum below Channel 37 effectively unworkable with any other spectrum below 1 GHz. That ***hugely*** devalues the spectrum even if you buy into the premise that pure downlink bands are a good thing. Worse, it creates a "two-tiered" auction in which participants will bid either for "good spectrum" above Channel 37 or "consolation prize" spectrum below Channel 37. Even worse, no one with lowband spectrum will bid on the SDL spectrum below 37 even if they are outbid/forced out of the "good" spectrum above Channel 37.

Oh, someone will likely buy the licenses if they are put up for sale. After all, if the licenses are cheap enough a rich enough bidder can afford to speculate (look at SpectrumCo in the AWS-1 auction, for example, which Comcast described in 2006 as acquiring a national footprint cheap to "provide greater flexibility and strategic options" and which the cable guys never did figure out how to use until they sold it to Verizon). But unlike previous auctions, there is actually a real incremental cost to adding more spectrum to the Incentive Auction. Before money goes to the Treasury, the FCC must deduct costs of clearing the additional spectrum. That means paying off more broadcasters (who will price their clearance at the maximum value, not at the reduced marginal value of the additional spectrum) and increased difficulty/expense of repacking.

Let me elaborate on that last point. From the perspective of the broadcaster, I price my license as the most valuable license reclaimed, based on my theoretical expectation of what I could ideally get for it under the best circumstances. Since all broadcasters are being advised by the same experts with access to the same data, we should expect their opening bids to come in pretty close to one another unless they are somehow given incentive to bid lower. (I cover this discussion in more detail over here.)

But for the U.S. Treasury, the value of auctioning spectrum is a question of the marginal value of the spectrum v. the marginal cost of adding that spectrum. Given the nature of the Incentive Auction, it is entirely possible that the marginal cost of clearing an additional television broadcaster in a market to secure more spectrum may actually ***cost more than the government can make from selling it*** because the marginal cost of clearing that broadcaster is actually greater than the value the government can get from the additionally cleared spectrum — either because the spectrum itself is less valuable, because the cost of clearing the additional broadcaster is high, or because the addition of the spectrum impacts the structure of the auction as a whole in a negative way.

The pure Down From 51 auction plan favored by industry creates exactly this problem if the spectrum collected is more than the 84 MHz needed to clear down to Channel 37. Creating SDLs below Channel 37 (each of which will also need guardbands) drives up the cost of the auction to the government for very marginal return. It also reduces the number of potential bidders for the "good auction" above 37 by diverting marginal bidders to the "consolation auction" below 37, thus decreasing revenue even for the good spectrum. (This later effect is probably less significant to the overall increase in marginal cost as compared to potential marginal value for spectrum cleared below Channel 37.)

In addition to these revenue effects, there are also significant competition issues that are important. The providers that lack spectrum below 1 GHz today are the ones that most need uplinks in the lowband spectrum as well as downlinks. But they are the only ones capable of using the downlink spectrum, and even then only if they bid exclusively on the supplementary downlinks. This leaves the paired spectrum (with the valuable lowband uplinks) to AT&T and Verizon — the carriers which already have the largest holdings of lowband sub-1 GHz spectrum. This is one reason why Sprint hates this plan. T-Mobile loves this plan, provided the FCC also adopts aggregation limits that would keep paired spectrum from AT&T and Verizon.

You may ask why so many carriers and equipment manufacturers love Down from 51 if it creates so many problems. The answer is that carriers do not give a crap about raising money for Treasury. Same thing for broadcasters. As long as the FCC is forced to take any spectrum available, no matter what the marginal cost or impact on the auction, broadcasters will maximize revenue. The fact that the broadcaster revenue maximization strategy conflicts with the U.S. Treasury revenue maximization strategy is something folks like Rep. Greg Walden (R-OR), Chair of the Communications Subcommittee of the House Energy and Commerce Committee, should keep in mind before sending off yet-another letter to the FCC telling the FCC to suck up to the broadcasters.

If the FCC does adopt a Down From 51 FDD auction, it really ought to explicitly limit the total amount of spectrum it will clear to the 84 MHz needed to reach Channel 37. That would push broadcasters to accept a lower clearance price (lest they price themselves out of the auction) and would simplify development of the band plan. Otherwise, the marginal cost of recovering additional spectrum appears to outweigh the likely revenue from that spectrum, as well as creating serious competition issues (unless the FCC adopts aggregation limits, which Chairman Walden also vociferously opposes).

3. The approach that gives the most spectrum in absolute terms for licensing is the all TDD (time division duplexing) plan. Start clearing from Channel 51 and keep going. (Call this "Down from 51 TDD.")

This does not fully solve the antenna problem, but by eliminating the need for uplink and downlink spectrum and requiring a certain level of coordination among providers (such coordination being a pre-requisite for avoiding interference when using TDD), the FCC can use the spectrum above 37 without a duplex gap, maximizing the available spectrum without worrying about fungibility so much. Even here, you will need significant guard band spectrum between the new 600 MHz spectrum and the existing 700 MHz spectrum, and on the other end south of Channel 37 between 600 MHz and broadcasting.

This plan still requires significant repacking because it eliminates the duplex gap. But you could arguably get the most efficient use of spectrum with a modest guardband between the existing 700 MHz band and the new 600 MHz band and a somewhat larger guardband between the surviving broadcasters and the 600 MHz band. If things worked out right, you would incorporate Channel 37 into the lower guardband.

Sprint and Clearwire, which already have TDD networks, are the prime proponents of this plan. Most of the rest of the industry hates this plan, because they use FDD (frequency division duplexing).

If you are solely focused on minimizing guard band space, TDD is your boy, because it eliminates the duplex gap (which imposes separation of at least 10 MHz between significantly sized blocks of spectrum — possibly more depending on how big you want the uplink and downlink blocks to be. The larger the uplink and downlink blocks, the more throughput — but the larger the duplex gap needs to be). But since most of the industry will have added cost in shifting from FDD to TDD, they will arguably discount their auction bids accordingly to reflect this additional cost. Nor does this solve the antenna problem. If the FCC manages to reclaim sufficient spectrum that it makes sense to extend below Channel 37, you start to end up with spectrum that is difficult to match with other low-band spectrum from an antenna spectrum. OTOH, because of the way TDD works, you could use any of that spectrum for uplink or downlink. This at least partially mitigates the "two-tiered auction" problem with the Down From 51 FDD plan by eliminating the pure Supplemental Downlink licenses, although it does not entirely eliminate the antenna compatibility problem.

So odds are good you still have a two-tiered auction even with TDD, one auction for the good licenses above Channel 37 and the other for the much less good licenses below Channel 37. But at least TDD makes maximum use of the good spectrum above Channel 37 and increases overall value of the licenses below Channel 37. At least, for those carriers that like TDD and will not incur additional expense from incorporating TDD licenses into their FDD networks.

Conclusion

This is a very preliminary and very surface reaction. To any one of these, there is a possible "yes but –" that the FCC must consider in its bandplan trade offs. My key point is not to favor a particular band plan (although I think the FCC's actual proposed plan, the Down From 51/Down From 31 plan, is probably the easiest to implement, avoids the worst competition problems, and best avoids the marginal cost problem if the FCC gets more than 84 MHz of spectrum).

My actual point is that people who have not considered these technical issues but keep insisting that the FCC ever and always ought to maximize the amount of spectrum it recovers (oh, and eliminate "wasteful" guardbands as well) need to actually take a look at these things if they actually care about maximizing revenue — or any other outcome. If you really believe that the FCC ought to be focused on paying off FirstNet and general deficit reduction and nothing else, then you need to stop saying stupid things like "always maximize the amount of spectrum recovered and sold" and "always listen to the broadcasters and the carriers if you want to have a successful auction."

Yes, I am looking at the House Commerce Committee Republicans in particular, although they re not the only ones. But for anyone who thinks

they can do a better job designing this auction than the FCC — which actually has real auction experts and 20 years experience designing auctions — then you need to look at the technical band plan issues. Otherwise, to quote my favorite characters from Pearls Before Swine: "Peese Shut Beeg Fat Mouf."

Stay tuned . . . .

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2 Comments

Christopher Mitchell
Posted May 6, 2013 at 9:41 am | *Permalink* | *Edit*

Umm, Harold I think you are forgetting that there is a blue telephone booth that may be more likely to work for taking you back in time… Alas the great George Carlin will not be your guide. Lame.

Michael Elling
Posted May 6, 2013 at 2:40 pm | *Permalink* | *Edit*

Whew. And I was afraid this would be simple and our wireless bills would go down soon. This analysis really does a good job to explain how likely things will stay the same. Seriously, of all the possible candidates, Mr. TW appears the best candidate for coming up with a King Solomon like solution.

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